Financial Intermediary Development and Growth Volatility: Do Intermediaries Dampen or Magnify Shocks?

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Abstract: We extend the recent literature on the link between financial development and economic volatility by focusing on the channels through which financial intermediary development affects economic volatility. Building on Bacchetta and Caminal (2000) our theoretical model predicts that the effect of real sector shocks on growth volatility is dampened by well-developed financial intermediaries, while monetary shocks are magnified, suggesting that, on average, there is no unambiguous effect of financial intermediaries on growth volatility. We test these predictions in a panel data set covering 63 countries over the period 1960-97, using the volatility of terms of trade and inflation to proxy for real and monetary volatility, respectively. We find (i) no robust relation between financial intermediary development and growth volatility, (ii) weak evidence that financial intermediaries dampen the effect of terms of trade volatility, and (iii) some evidence that financial intermediaries magnify the impact of inflation volatility in countries where firms have little or no access to external finance through capital markets.

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1. Introduction

Do economies with higher levels of financial intermediary development experience more or less volatility in economic growth rates? Do intermediaries dampen the impact of external shocks on the economy or do they amplify them through the credit channel? While the recent empirical and theoretical literature has established a positive impact of financial sector development on economic growth, the potential links between financial development and the volatility of economic growth have not been studied thoroughly yet.[1] Still, the high growth volatility that many developing countries experience has brought to the forefront the question whether and to what extent output fluctuations can be related to the development of the financial sector.

This paper tries to shed light on the links between financial intermediary development and growth volatility both theoretically and empirically. Previous papers have found that financial development reduces macroeconomic volatility (Easterly, Islam, and Stiglitz, 2000; Denizer, Iygun, and Owen, 2000; Gavin and Hausmann, 1995, Raddatz, 2003). However, none of these papers has tried to identify the channels through which financial development potentially affects growth volatility. This paper examines whether financial intermediaries serve as shock absorbers mitigating the effect of real and monetary volatility on growth volatility, or whether they magnify their impact.

Our work is related to three different strands of literature. First, we build on a large empirical literature on the relation between financial development and economic growth.[2] Financial intermediaries and markets emerge to lower the costs of researching potential investments and projects, exerting corporate control, managing risks, and mobilizing savings. Economies with better-developed financial intermediaries and

markets therefore enjoy higher growth rates. This literature, however, does not explore the impact of financial development on the volatility of economic growth rates.

A second relevant strand of literature has emphasized the magnifying effect that capital market imperfections have on the propagation of real sector shocks. In particular, Bernanke and Gertler (1990) show that shocks to the net worth of borrowers amplify economic up- and downturns, through an accelerator effect on investment.[3]

A third related line of work is the literature on the credit channel of monetary policy (Bernanke and Blinder, 1988 and Bernanke and Gertler, 1995).[4] According to the credit channel view, monetary policy impacts the real economy through its effects on the credit market. Through their impact on borrowers' profitability, asset value and thus collateral, interest rate changes directly affect borrowers' ability to borrow (balance sheet effect).[5] The supply of loanable funds is affected if banks cannot easily replace deposit liabilities and if banks' assets are not perfectly substitutable (bank lending channel).[6]

This paper makes several contributions. Building on a model by Bacchetta and Caminal (2000), we show that depending on their nature, shocks to the economy are dampened or magnified by well-developed financial intermediaries.[7] While real sector shocks, i.e. shocks that affect only nonfinancial firms in the first round, are dampened in their effect on output volatility by financial intermediaries, monetary shocks, i.e. shocks to the banks' balance sheets, are magnified. Overall, our model does not predict an unambiguous relation between financial development and growth volatility, but different interactions of intermediaries with different sources of volatility.

Second, we complement our theoretical model with panel estimations for a sample of 63 countries over 38 years. We assess whether financial intermediary

development, defined as outstanding credits to the private sector relative to GDP, affects the impact of terms of trade and inflation volatility on economic growth volatility. Specifically, we regress the volatility of real per capita GDP growth on our measure of financial intermediary development, the volatility of terms of trade changes and inflation, and interaction terms of financial development and both volatility measures, controlling for other potential determinants of growth volatility. To test the robustness of our results, we split the sample period in different ways and use different econometric methods. Furthermore, we conduct a variety of specification tests. Finally, we test for a differential interaction of financial intermediary development with terms of trade and inflation volatility for countries with developed stock markets, assuming that firms in these countries have alternative sources of external finance to bank finance.

Overall, the exploratory empirical work gives qualified support for the hypotheses derived in our model. We do not find a robust relation between financial intermediary development and growth volatility. We find weak evidence for a dampening effect of financial intermediary development on the impact of terms of trade volatility. We find a positive interaction term of financial intermediary development with inflation volatility for countries where firms have limited or no access to capital markets, while we find no effect of monetary volatility among countries with well-developed stock markets.

The remainder of the paper is organized as follows. Section 2 presents a simple theoretical model and sets out the main testable hypotheses. Section 3 describes the data and the testing strategy. Section 4 discusses the main findings, while Section 5 concludes.

2. A Simple Model of Financial Development and Output Volatility

In this section, we describe a simple two-period model that builds on a model developed by Bacchetta and Caminal (2000).[8] Entrepreneurs differ in their level of wealth and therefore access to the capital markets. Financial intermediaries arise due to informational asymmetries between lenders and borrowers. Unlike in Bacchetta and Caminal, however, we will model the financial intermediaries explicitly and will introduce a channel for monetary policy in the form of reserve requirements. Further, we will introduce two classes of shocks, real shocks that affect only nonfinancial firms in the first round, and monetary shocks that affect only banks' balance sheets in the first round. Since entrepreneurs produce at different productivity levels, depending on their level of internal resources, real and monetary shocks will have distributional effects that will result in a dampened or magnified effect on output depending on the nature of the shock.

2.1. The Real Sector

All individuals in our model are consumers and entrepreneurs. Although all entrepreneurs have access to the same production technology *f(k)*, they are endowed with different levels of wealth *b*. The fraction β of agents are High wealth entrepreneurs and the share $(1-\beta)$ are Low wealth entrepreneurs. Entrepreneurs can choose between different investment projects that imply different degrees of efforts and thus different probabilities of success. While High entrepreneurs can fully finance their investment and have excess funds, which they deposit with banks, earning a riskless rate r^D, Low entrepreneurs cannot fully finance their investment with their own funds and will borrow funds at the lending rate r^L. Due to asymmetric information about the type of investment

and effort entrepreneurs choose, and the resulting potential moral hazard problems, Low entrepreneurs face agency costs φ . The relative marginal productivity of the High and Low entrepreneurs can then be described as follows:

$$\frac{f'(k^L)}{f'(k^H)} = \varphi \frac{r^L}{r^D} \qquad (1)$$

The higher the agency costs or the wedge between lending and deposit rates, the higher the ratio k^H/k^L and the larger the wedge between the marginal productivity of Low and High entrepreneurs. Given the different levels of productivity, a reallocation of funds between the two entrepreneurial classes affects aggregate productivity and therefore output in the economy. The larger agency costs, the larger the effect of a reallocation.

2.2. The Financial Sector

The asymmetric information in our economy gives rise to financial intermediaries that can internalize the agency costs. High entrepreneurs deposit their excess funds with financial intermediaries whereas Low entrepreneurs borrow from intermediaries to complement their own funds. Intermediaries operate in a perfectly competitive environment, face no costs and can only hold loans as assets. However, deposits are subject to reserve requirements imposed by the monetary authority, so that loans supplied to Low entrepreneurs equal $(1-\tau)$ times the deposits of High entrepreneurs, where τ is the reserve requirement. There are no other liabilities and thus no other sources of funding for banks. We assume these reserve requirements are not remunerated and are not used for productive purposes.[9] An increase in τ, i.e. a monetary tightening, implies a decrease in resources available for lending to Low entrepreneurs, whereas a decrease in τ, i.e. a

monetary easing, implies an increase in loanable funds. Financial intermediaries have thus two functions in our model: They arise out of market frictions and channel flows from High to Low entrepreneurs, i.e. from the surplus to the deficit sector, and they serve as conduit for monetary policy. Aggregate loan supply of the financial intermediary sector can thus be written as:

$$(1-\tau)\beta(b^H - k^H) = (k^L - b^L)(1-\beta) \tag{2}$$

Since, as we show below, in equilibrium there is no uncertainty concerning repayment by borrowers, the ratio of the lending and deposit rate depends only the reserve requirement τ .

$$\frac{r^D}{r^L} = (1-\tau) \tag{3}$$

The asymmetric information and resulting agency costs lead to sub-optimal investment of Low entrepreneurs. As described in Bacchetta and Caminal (1996, 2000) and in the appendix, assuming certain functional forms for the production function, the nature of agency costs and for their level of equity, Low entrepreneurs will always choose the most efficient project, but will be credit constrained, in the sense that their investment level is suboptimal. Agency costs are described by $\varphi = \omega(1-\frac{b^L}{k^L})$, where ω is a function of exogenously given technological parameters. The demand for loanable funds by Low entrepreneurs therefore decreases in r^L, ω and leverage ratio k^L/b^L. The supply of loanable funds by High entrepreneurs, on the other hand, is only a function of the interest rate r^D and reserve requirement τ.

Our model thus combines the characteristics of a model with endogenous financial intermediation with conditions for the existence of a bank lending channel of

monetary policy: (i) firms cannot substitute bank lending with alternative sources of finance, and (ii) the monetary authority is able to affect the supply of loans.

2.3. General Equilibrium

Following Baccetta and Caminal, we embed the previously described partial equilibrium model of entrepreneurs and banks into a simple two-period overlapping generations model. As explained in more detail in the appendix, the relative marginal productivity of High and Low entrepreneurs can be described as follows:

$$\frac{f'(k^L)}{f'(k^H)} = \omega(1-\frac{b^L}{k^L})\frac{r^L}{r^D} = \omega(1-\frac{b^L}{k^L})(\frac{1}{1-\tau}) \qquad (4)$$

while the market clearance condition for financial markets yields:

$$\beta b_t^H + (1-\beta)b_t^L = \beta k_t^H + (1-\beta)k_t^L + \tau\beta(b_t^H - k_t^H) \qquad (5)$$

Using these two equations, it can be shown that the relative investment of Low entrepreneurs k^L/k^H increases in the ratio of internal to total resources b^L/k^L and in their relative wealth share b^L/b^H, and decreases in agency costs ω and reserve requirements τ. The positive effect of a higher b^L/k^L and b^L/b^H on k^L/k^H increases in the agency costs ω.[10]

2.4. Shocks

We can now explore the effects that different shocks have on the relative composition of investment and output, and therefore output volatility. We will distinguish between shocks that affect only the real sector, i.e. the internal funds available to entrepreneurs of both classes and shocks that affect the financial sector and therefore

the external funds available to Low entrepreneurs. We are especially interested in the effect that the agency costs have on the scale of these output changes. [11]

Consider an unanticipated shock (κ) to the production function, that hits the economy during the first period, after all investment decisions have been made, i.e. $y_t = \kappa f(k_t)$. This shock can be caused by either improved technology or by lower input prices.[12] The profits of the leveraged, i.e. the Low entrepreneurs, increase more than proportionally, which increases the relative wealth of Low entrepreneurs b_{t+1}^L / b_{t+1}^H and therefore relative investment by Low entrepreneurs in the following period. Since Low entrepreneurs produce at a higher marginal productivity than High entrepreneurs, this shift in relative investment towards Low entrepreneurs magnifies the effect of the productivity shock under imperfect capital markets. The higher agency costs and thus the higher the difference in marginal productivity are, the more magnified is the shock.[13]

Result 1: *The relative output effect of a shock that leads to a change in b^L/b^H is larger under asymmetric information than under perfect capital markets. The size of the output change increases in agency costs ω.*

Better-developed financial intermediaries alleviate the cash-flow constraint for Low entrepreneurs and thus dampen the impact of shocks to the production function. Note that these shocks only affect the demand for loanable funds, but do not shift the supply curve. Further, they affect banks' balance sheets only in the second round, through shifts in the loan demand curve.

A loosening of monetary policy through the decrease of reserve requirement τ increases the supply of loanable funds and decreases the interest rate r^L. However, it also increases the leverage and thus the agency cost constraint for the Low entrepreneur. This

partly offsets the positive impact of lower reserve requirements.[14] This dampening effect, however, decreases as agency costs decrease. Lower agency costs ω, i.e. more financial development, therefore, increase the output effect of monetary shocks.

Result 2: *The relative effect of a shock that changes the supply of loanable funds to Low entrepreneurs is smaller under asymmetric information than under perfect capital markets. The effect of the output change decreases in agency costs* ω.

Financial intermediaries thus have a magnifying effect on monetary shocks. In financially more developed economies, Low entrepreneurs depend more on external finance and therefore suffer more if banks' balance sheets are affected by monetary policy changes. Shocks that affect intermediaries in the first round are transmitted into the real sector, and this effect is stronger for financially more developed economies.

This effect is comparable to the credit channel of monetary policy, and more specifically the bank-lending channel. Unlike the theoretical literature of the bank-lending channel that focuses on the imperfect substitutability of money, bonds and loans, we focus only on loans and on reserve requirements as monetary policy tool. As in this literature, we focus on the distributional rather than the aggregate effects of monetary policy. Unlike this literature, however, we do not focus on the difference between the cost of internal and external finance, but rather on credit rationing.

On the first look, Result 2 seems to contradict the results derived by the literature on the credit channel of monetary policy, that firms with higher agency costs are more subject to the volatility caused by monetary shocks. The different conclusions can be explained by the different variation we exploit. Whereas the credit channel literature holds the degree of financial intermediary development constant and considers firms with

different degrees of agency costs, our model holds the variation of agency costs across firms in a given country constant and varies the degree of financial intermediary development. Further, our theoretical model does not take into account other sources of external finance, such as capital markets, certainly an unrealistic assumption for many financially developed countries. More financial intermediary development therefore translates – unlike in the credit channel literature – into more bank-dependence. In the empirical part, however, we will qualify this simplistic statement.

2.5. An Extension to Growth

While the theoretical model only considers two periods, we could extend it to a multi-period model. While we have only considered shocks and their effects on output, we can extend the analysis easily to real and monetary volatility and its effects on growth volatility.[15] First, we recast our model in terms of deviations from an exogenously given trend growth rate to control for different growth trends across countries that are not related to volatility. Similarly, unanticipated real and monetary shocks are recast as deviations from real and monetary trends. Specifically, κ is reinterpreted as deviation from $\underline{\kappa}$, a trend productivity growth rate or trend growth rate in input prices; changes in τ are reinterpreted as policy changes that result in deviations from a trend monetary growth or inflation rate. We can now summarize as follows.

Result 3: *The effect of real (monetary) volatility on output and growth volatility is larger (smaller) under asymmetric information than under perfect capital markets and increases (decreases) in agency costs* ω.

2.6. Testable Hypotheses

Our theoretical model provides two testable hypotheses. First, it suggests that we should not expect to find an unambiguous relation between financial intermediary development and growth volatility, on average. Rather, the relationship should depend on the relative importance of real and monetary volatility in an economy. An insignificant relationship between financial intermediaries and growth volatility, however, can be interpreted as evidence in favor of the model or as evidence against any role of intermediaries in dampening or magnifying the impact of real and monetary volatility. A second testable hypothesis is that we should not find an independent effect of financial intermediaries on growth volatility beyond their effect on dampening real and magnifying monetary shocks. Subject to correct specification, this is a more direct test of our model. In our empirical analysis, however, we will not test reduced forms derived explicitly from the model, but rather use standard cross-country volatility regressions, augmented as necessary. This allows us to control for other determinants of growth volatility that we cannot capture in the simple model described above.

We need proxies for sources of real and monetary volatility, affecting producers and intermediaries. We will use the standard deviation of terms of trade changes to proxy for the extent to which an economy is exposed to real sector shocks and the standard deviation of the inflation rate to proxy for the extent to which an economy is exposed to monetary shocks. Both variables are certainly imperfect proxies. Changes in terms of trade affect producers and their balance sheets through relative price movements in imported inputs and exported output. Terms of trade changes, however, affect only the tradable sector of an economy directly, whereas the non-tradable sector might be affected

only indirectly. Countries with large non-tradable sectors will therefore be relatively less affected by fluctuations in terms of trade. We control for this by including the ratio of trade to GDP in our estimation below. Also, inflation volatility might reflect not only monetary policy volatility, but other factors as well, such as demand shocks and business cycle effects.[16]

3. Data and Econometrics

3.1. The Data

We use a sample of 63 countries with data for the period 1960 to 1997 and create three panel data sets by aggregating data over different time periods.[17] This serves partly as a robustness check on the results, and partly to avoid the problems caused by aggregating on unusual initial- or end-years. Our constructed data sets are a three-period panel (aggregated over the periods 1960-72, 1973-85, and 1986-97), a four-period panel (1960-69, 1970-78, 1979-87, 1988-97), and a six-period panel (1960-66, 1967-72, 1973-78, 1979-84, 1985-90, 1991-97). We will focus the discussion here and in the empirical results on the three-period panel, since it provides the most efficient estimates of standard deviations (i.e. based on the largest number of observations). Table 1 describes the data and Table 2 presents correlations.

The dependent variable is the standard deviation of growth in real GDP per capita within each time period. For the three-period sample, this ranges from a minimum of less than 1% (France and the Philippines in the first period, Sri Lanka in the middle period, and Ghana in the most recent period) to about 11% (Lesotho in the middle period),

around a median of 2.5% (which is larger than the median growth rate for the sample of 2.1% per year).

Our measure of financial intermediary development is Private Credit, the claims on the private sector by financial intermediaries as share of GDP. Private Credit measures the most important activity of the financial intermediary sector, channeling funds from savers to investors, and more specifically, to investors in the private sector.[18] It therefore relates directly to our theoretical model, since lower agency costs rely in higher supply of loanable funds. Levine, Loayza and Beck (2000) and Beck, Levine, and Loayza (2000) show that Private Credit has a significantly positive and economically large impact on economic growth. Private Credit also varies significantly across countries, from less than 1% of GDP (Haiti and Congo (Zaire)) to nearly twice the level of GDP (Switzerland and Japan).[19]

To control for the fact that firms in many countries have alternative sources of external finance, we create a dummy variable that takes the value one if the country's stock market capitalization as share in GDP, averaged over the period 1975-1997, is above the median of the sample (13.5%), and zero otherwise. While stock market capitalization does not measure directly the share of firms with access to capital markets, we conjecture that firms in countries with relatively larger stock markets are more likely to have access to capital markets. The lack of data on stock market development for a large number of countries before 1975 prevents us from exploring in more detail the effect of alternative sources of external finance on the relation between financial intermediary development and growth volatility. We therefore rely on this cross-

sectional dummy variable to capture the extent to which firms can rely on sources of external finance other than financial intermediaries, specifically on capital markets.

We use the standard deviations of terms of trade changes and inflation over the corresponding periods to proxy for the degree to which an economy is subject to real and monetary shocks and thus volatility. As indicated in Table 1, there is a large variation across countries in terms of trade and monetary volatility.

In the multivariate analysis below, we include the log of real GDP per capita and a measure of trade openness, specifically the log of the sum of exports and imports relative to GDP. There is considerable evidence that wealthy countries are more stable.[20] Greater openness, on the other hand, increases a country's exposure to changes in the terms of trade.

Table 2 presents correlations for the 3-period sample.[21] We note that more developed countries, as measured by a higher real GDP per capita, experience less variability in growth, terms of trade and inflation. Similarly, financially more developed economies experience less volatility in growth, terms of trade changes and inflation. Growth volatility is positively correlated with volatility in inflation and terms of trade changes.

3.2. Econometric Methodology

To test our hypotheses we will run the following reduced-form regression:

$$\begin{aligned} SD(Growth)_{i,t} &= \alpha_1 SD(\Delta TOT)_{i,t} + \alpha_2 SD(Inflation)_{i,t} + \beta FD_{i,t} \\ &+ \gamma_1 FD_{i,t} \times SD(\Delta TOT)_{i,t} + \gamma_2 FD_{i,t} \times SD(Inflation)_{i,t} + \delta CV_{i,t} + \mu_i + \varepsilon_{i,t}, \end{aligned} \quad (11)$$

where *SD(Growth)* is the standard deviation of real per capita GDP, *SD(ΔTOT)* and *SD(Inflation*) are the standard deviations of terms of trade changes and inflation,

respectively, *FD* is our measure of financial intermediary development, Private Credit, *CV* is a vector of control variables, μ is a country-specific effect, ε is the error term and *i* and *t* denote country and time period, respectively.

To explore the impact of financial intermediary development on the propagation of real and monetary volatility, we have to consider (i) the sign and significance of the interaction terms γ_1 and γ_2, and (ii) the significance of terms of trade and inflation volatility at different levels of Private Credit. A negative (positive) sign on γ_1 (γ_2) would indicate a dampening (magnifying) role of financial intermediaries in the propagation of real (monetary) volatility and would thus be consistent with our theoretical model. However, if variance in financial intermediary development is to explain cross-country differences in the propagation of real and monetary volatility, the overall impact of real and monetary volatility has to vary across different levels of financial intermediary development. We are therefore interested in $\alpha_1 + \gamma_1 * \underline{FD}$ and $\alpha_2 + \gamma_2 * \underline{FD}$, where $\underline{FD}$ denotes a specific level of Private Credit, at different levels of Private Credit. Finally, our model would predict $\beta=0$, so no significant effect of financial intermediary development on growth volatility beyond its dampening and magnifying effect on the propagation of real and monetary volatility, respectively. We also run regressions controlling for a separate interaction term of financial intermediary development with both terms of trade and inflation volatility for countries with well-developed stock markets.

The interaction terms in these regressions are by definition correlated with their components. This gives rise to the problem of multicollinearity. While this does not necessarily bias the estimates, it does increase the size of the estimated variance, and,

given the relatively small sample sizes, may cause instability in the parameter estimates. Examination of variance inflation factors[22] reveals that volatility in terms of trade changes is the largest sources of collinearity. In our empirical work, this might lead to the case where the parameter estimates on Private Credit and its interaction with the respective volatility measure are individually insignificant, but jointly significant.

To control for biases introduced by the estimation of panel data, we use two different estimation strategies. The data combine cross-country and time-series, which enables estimation by conventional panel-data techniques, such as random- or fixed-effects regressions. These panel-data estimators are asymptotically normal as $T \to \infty$, but in small samples, and especially when the number of groups exceeds the number of time periods, these estimators yield overly optimistic standard errors, and lead to overconfidence in the results (Beck and Katz 1995). Our base regression is instead a pooled OLS using panel-corrected standard errors, as suggested by Beck and Katz.[23] This allows us to correct for errors that are both heteroskedastic (that is, they differ systematically across countries) and correlated over time within countries. While the parameter estimates are found by the conventional method $\hat{\beta} = (X'X)^{-1}X'Y$, the estimated variance matrix is given by $(X'X)^{-1}X'\Omega X(X'X)^{-1}$, with $\Omega = \frac{E'E}{T} \otimes I_T$, where E denotes the T x N matrix of the OLS residuals and $\otimes$ is the Kronecker product.[24]

Since the variance correction (weighting) matrix Ω does not assume a specific time-series error structure, we conduct an *ad-hoc* test for serial correlation, by estimating a common serial correlation coefficient $\bar{r} = \sum_i w_i r_i$, where r_i is the estimate of the within-country serial correlation, and w_i is a weight derived from the reciprocals of the

variances, which increases the efficiency of the estimates (Greene, 1993, p.457). The *ad-hoc* nature of the test is that we consider the test significant if the serial correlation coefficient is close to or above 0.3, the rule-of-thumb for correction suggested by Grubb and Magee (1988). We find significant serial correlation only in the 6-period sample, for which we present both the OLS and corrected estimates using the Prais-Winsten transformation.

We present two additional tests. First, we present a likelihood ratio test of group-specific heteroskedasticity, following Greene (1993, p.397). Rejection of this test indicates that the errors differ significantly across countries, requiring the use of some panel-correction estimation method. Second, we test for the endogeneity of Private Credit, and its interactions, using the Davidson-Mackinnon test of exogeneity (Davidson and Mackinnon, 1993). This is similar to the Wu-Hausman test, with the null hypothesis that the ordinary least squares (OLS) estimator is consistent with the instrumental variables estimator. A rejection of the null indicates that the endogeneity of the regressors has a significant influence on the estimates, and that the equation should be properly estimated using instrumental variables. We use as instruments dummy variables indicating the source of legal tradition, a dummy variable indicating commodity exporters, and the urban population share in the total population.[25] In no case can we reject exogeneity.[26]

4. The Results

This section presents the regression results from a 63-country panel, with data averaged over three, four or six sub-periods over 1960-97. We present three sets of

results. First, we discuss results from a regression without interaction terms (Table 3). While this does not link directly to the theoretical model, it helps us relate our paper to previous studies on the impact of financial development on growth volatility. We then present the regression results with one interaction term (Tables 4A and B), and subsequently on regressions with two interaction terms, specifically one overall interaction term and one for countries with well-developed stock markets only (Tables 5A and B).

Table 3 suggests a large and statistically significant impact of both terms of trade and inflation volatility on growth volatility, while no robust impact of financial intermediary development. The standard deviations of terms of trade changes and inflation enter positively and significantly at the 1% level in all regressions, while Private Credit enters negatively at the 10% significance level in two regressions (3-period and 6-period OLS) and insignificantly in the other two. Further, the effect of real and monetary volatility is relatively large. If we take the 3-periood regressions, then increasing the standard deviation of terms of trade changes from the 25^{th} (0.04) to the 75^{th} (0.11) percentile results in 0.5 percentage points higher growth volatility (compared to a median of 2.5%), while increasing inflation volatility from the 25^{th} (0.02) to the 75^{th} (0.26) percentile results in 0.4 percentage point higher growth volatility. These results are consistent with our theoretical model, as we find no unambiguous relation between financial intermediary development and growth volatility. We also note that more open economies suffer larger swings in their growth rates, while there is no independent relation between per capita income and growth volatility.

Tables 4A and B show (i) only weak evidence for a dampening effect of financial intermediary development on the propagation of terms of trade volatility, (ii) somewhat stronger evidence for a magnifying effect on the propagation of monetary volatility, and (iii) again no unambiguous overall relation of intermediaries with growth volatility. While the standard deviation of terms of trade changes enters significantly at the 10% level only in the 4-period and the 6-period AR(1) regressions and its interaction with Private Credit only enters significantly at the 10%-level in the 4-period regression, both terms enter jointly significantly at the 5%-level in all regressions.[27,28] While the standard deviation of inflation does not enter significantly in any of the regressions, its interaction with Private Credit enters positively in all regressions, and it enters significantly at the 10% level in the 3- and the 4-period estimations; both enter jointly significantly at the 5%-level in all regressions. Private Credit does not enter significantly in most regressions – except for the 6-period OLS results – and together with the two interaction terms it is insignificant at the 5% level in all regressions.

Table 4B presents the total effects of a change in the measures of real and monetary volatility on growth volatility, at different levels of Private Credit. Overall, these results do not prove that for a given country, the impact of terms of trade volatility is reduced as it develops better financial intermediaries; we cannot reject the hypothesis that the impact of terms of trade volatility is the same at the 25^{th} and the 75^{th} percentile of Private Credit. The results suggest that the impact of inflation volatility on growth volatility is increasing in financial intermediary development; there is a significant relation between inflation volatility and growth volatility at all levels of Private Credit,

and we can reject the hypothesis that the impact of inflation volatility is the same at the 25th and the 75th percentile of Private Credit.

To assess the effect of financial intermediaries on magnifying inflation volatility we consider differences in differences, i.e. the difference in growth volatility at 25th and 75th percentile of inflation volatility and Private Credit. For the 3-period regression, the effect of this change in inflation volatility on growth volatility is 0.6 percentage points at the 25th percentile of Private Credit and 0.8 percentage points at the 75th percentile.

The results in Table 5A and B confirm the weak evidence for a dampening effect of financial intermediary development on the propagation of terms of trade volatility, while providing evidence for a magnifying role of financial intermediaries in the propagation of monetary shocks in countries with less developed stock markets. As before, terms of trade volatility and its interaction terms with Private Credit are individually mostly insignificant, but jointly significant at the 5% level (Table 5A). The interaction of Private Credit with inflation volatility is positive and significant at the 10% level in the 3- and 4-period samples, while the interaction for countries with well-developed stock exchanges is negative, but not significant. Inflation volatility and the interaction terms are jointly significant at the 10%-level in all regressions. Private Credit does not enter any of the regressions significantly at the 5% level, except for the 6-period OLS regression and it is jointly insignificant with the four interaction terms in all regressions.

The analysis of the marginal impact of terms of trade volatility at different levels of Private Credit confirms our previous results that there is no significant difference in the impact of terms of trade volatility in countries at the 25th and the 75th percentile of

Private Credit; this holds both for economies with and without well-developed stock markets (Table 5B).

There is a significant impact of inflation volatility at all levels of Private Credit for countries with less developed stock markets, which is decreasing in the level of financial intermediary development and significantly (10%) higher in countries at the 75th percentile of Private Credit than in countries at the 25th percentile in the 3- and 4-period regressions. There is no robust impact of inflation volatility in countries with well-developed stock exchanges – inflation volatility is insignificant at all levels of Private Credit.

Summarizing, we find only weak evidence that financial intermediary development might dampen the impact of terms of trade volatility on growth volatility. Our results suggest a magnifying role of the financial sector in the propagation of monetary volatility on growth volatility in countries with less developed stock exchanges, while there is no robust evidence for an impact of monetary volatility on growth volatility in economies with well-developed stock markets. There is no robust relation between Private Credit and growth volatility beyond the different interactions with real and monetary volatility.

The results of a positive interaction of Private Credit and inflation volatility in countries with less developed stock markets are consistent with the predictions of our theoretical model, while the results for the economies with well-developed stock exchanges do not completely match the theoretical predictions. This might be explained by the limitations of our model. In countries with less developed stock exchanges, the capacity of financial intermediaries to serve as conduit for monetary policy increases as

the financial sector develops and the real sector becomes more dependent on external financing. In most of these economies, our assumptions that banks cannot easily substitute deposits for other sources of funding and that firms do not have easy access to alternative source of external financing, might be appropriate. In countries with well-developed stock markets, on the other hand, there are two opposing effects. While firms depend more on external finance in financially more developed economies, both financial intermediaries and firms have easier access to other sources of funding, such as capital markets, which reduces the effectiveness of monetary policy (Ceccetti, 2001 and Kashyap and Stein, 1995).

5. Concluding Remarks

This paper (i) assessed the impact of financial intermediary development on growth volatility and (ii) explored two potential channels through which these two variables might be linked. In our theoretical model financial intermediaries arise to alleviate agency costs and cash flow constraints on entrepreneurs, increase the efficiency of overall investment and dampen the impact of real shocks. At the same time, financial intermediaries serve as conduit for monetary policy propagation into the real economy. Our theoretical model thus predicts a dampening effect of financial intermediaries on the propagation of real shocks and a magnifying effect on the propagation of monetary shocks. Depending on the shocks an economy is exposed to and the relative size of these shocks, financial intermediaries might therefore have an overall dampening or amplifying impact on growth volatility.

Our empirical analysis of 63 countries over the period 1960-97 gives qualified support for an interaction of financial intermediary development with real and monetary volatility. We confirm the prediction of no significant impact of financial intermediaries on growth volatility. However, we find only weak evidence for a dampening role of financial intermediaries in the propagation of terms of trade volatility. We find some evidence for a magnifying role of intermediaries in the propagation of monetary volatility in countries where firms have limited access to capital markets, while no role is apparent in economies with well-developed stock exchanges.

Previous studies have found a negative relation between indicators of financial development and growth volatility.[29] In contrast, our results suggest that financial intermediaries have no overall effect on growth volatility. This might be because financial intermediaries have contradictory effects on the propagation of real and monetary shocks, so that the overall effect is insignificant. However, while these results are strongly suggestive, they do not provide unconditional proof. We could not find a robust interaction between Private Credit and our measure of real volatility. This might be due to the weakness of our indicator (terms of trade volatility) or to limited relevance of this channel. Our measure of monetary volatility interacts with Private Credit only in countries with less developed stock exchanges. Finally, it is certainly inappropriate to generalize from only two proxies for real and monetary shocks. Future work might analyze alternative channels through which financial intermediaries have an impact on growth volatility.

Our results suggest some general conclusions. First, while well-developed financial intermediaries foster economic growth, they do not, independently, affect its

volatility. Second, instability in macroeconomic policies, namely in the conduct of monetary policy, increases growth volatility, an effect that is magnified by financial intermediaries in countries where firms have no or limited access to stock exchanges. Finally, our results do not imply that financial sector policies are irrelevant to the volatility that economies suffer. The ownership structure of the banking system, for example, might be important, especially the presence of foreign banks.[30] The integration of domestic with international capital markets might have an important impact on growth volatility.[31] Further, the regulatory and supervisory framework might have an impact on the extent to which financial intermediaries serve as absorbers or as propagators of exogenous shocks (Caprio and Honohan, 2001). Our empirical analysis should therefore be seen as exploratory rather than providing definite answers. Our results should not discourage policy makers from pursuing policies that foster financial development. They rather underline that financial intermediaries are not an all-cure.

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[1] See King and Levine (1993a,b) and Levine and Zervos (1998) for correlation between financial intermediary and stock market development and economic growth. Levine, Loayza and Beck (2000), Beck, Levine and Loayza (2000), Beck and Levine (2003), Neusser and Kugler (1998) and Rousseau and Wachtel (2000) provide evidence for a causal impact of financial development on economic growth. Also, Demirgüç-Kunt and Maksimovic (1998) show that firms in countries with an active stock market and large banking sector grow faster than predicted by individual firm characteristics. Rajan and Zingales (1998) show that industries that rely more heavily on external finance grow faster in countries with better-developed financial systems.

[2] For an overview of the theoretical literature, see Levine (1997). For the empirical literature, see the previous footnote.

[3] Acemoglu and Zilibotti (1997) show that the interaction of investment indivisibility and the resulting inability to diversify risk increases economic volatility, while Kiyotaki and Moore (1997) show that capital market imperfections can amplify the effects of temporary productivity shocks and make them more persistent. Finally, Aizenman and Powell (2003) show that a weak legal system and high monitoring costs lead to a multiplying effect of real shocks on production, employment and welfare.

[4] See also the literature cited in Kashyap and Stein (1995).

[5] A number of papers show that liquidity constraints become binding for small firms in the U.S., which depend more on bank loans than large firms, after the Fed tightens its monetary policy. See among others, Gertler and Hubbard (1989), Gertler and Gilchrist (1994), Bernanke, Gertler, and Gilchrist (1996), Kashyap, Lamont, and Stein (1994), Oliner and Rudebusch (1996), and Morgan (1998). See also the survey in Kashyap and Stein (1994).

[6] Kashyap and Stein (1995) and Kishan and Opiela (2000) present evidence for the U.S. that smaller banks' lending volume is more affected by changes in monetary policy than large banks' lending volume. Jayaratne and Morgan (2000) show that there is a positive correlation between loan growth and insured deposit growth in the U.S. and that this correlation increases in a bank's leverage. They interpret this as evidence for a bank lending channel of monetary policy.

[7] We thus abstract from other channels, such as risk diversification through financial intermediaries.

[8] For a detailed model development, see Bacchetta and Caminal (1996, 2000) and the appendix, available on request.

[9] An alternative way to introduce monetary policy in our model economy is by having bonds, i.e. assets with a safe return, but which are not a perfect substitute to loans. Open market operations by the Central Bank would then affect banks' bonds and due to the imperfect substitutability also loan holdings. See also Goodfriend (1995), who points out that in the U.S. the decrease in deposits that follows monetary tightening is due to demand shifts.

[10] The effect of a higher b^L/k^L, ω and τ follows directly from eq. (4), as well as the result that the effect of a higher b^L/k^L is increasing in ω. The effect of b^L/b^H follows from eqs. (4) and (5).

[11] We only consider unanticipated real and monetary shocks. Bacchetta and Caminal also consider the effects of other shocks, such as anticipated productivity shocks and shocks to aggregate savings. Agency costs, however, do not affect output volatility in these cases, so that there is no role for financial intermediaries in dampening or magnifying these shocks. Finally, Bacchetta and Caminal assess the effect of debt issue financed with future tax increase on High entrepreneurs. The debt issue and subsequent crowding out effect resembles our tightening of reserve requirements and its effect on output volatility is dampened by agency costs.

[12] Bacchetta and Caminal characterize this shock as productivity shock. However, this can be interpreted as any shock that affects the producer, either on the input/cost side or on the output/profit side.

[13] This can be seen from eq. (4) by taking the derivative with respect to b^L/k^L. The negative derivative increases in absolute terms in agency costs ω. See also Appendix B in Bacchetta and Caminal (2000).

[14] This can be seen by taking the derivative of eq. (4) with respect to τ. Without agency costs, this derivative is unambiguously positive. However, since leverage k^L/b^L increases with lower reserve requirements, a negative term is added to the derivative that increases in agency costs ω.

[15] Growth volatility can certainly be seen as an indicator of real volatility. However, we are interested in "exogenous" determinants of growth volatility, specifically stemming from real and monetary sources.

[16] We also considered other proxies for shocks, but data limitation prevented us from using them. Data on productivity shocks are not available for a broad cross-section of countries. Interest rate data would be a policy variable closer to our model. However, many if not most developing countries did not use interest rates as monetary policy tool, but rather suppressed interest rates artificially with the result of negative real interest rates in many countries. This would also require that we develop and include a set of historical indicators for quantity restrictions in capital markets, which is outside the scope of our inquiry.

[17] See Appendix Table 1 for the list of countries. We restrict the set of countries to those that have at least 8, 5, and 3 observations in the 3, 4, and 6-period samples, respectively. See Appendix Table 2 for data sources.

[18] Private Credit includes credit by both government-owned and private intermediaries. It would be preferable to focus on private banks. Times-series data on ownership structure of banks are, however, not available. Further, using data from La Porta, Lopez-de-Silanes, and Shleifer (2002), Beck and Levine (2002) calculate a modified measure of Private Credit that only includes private banks for the period 1980-90. The correlation between Private Credit and the modified measure is over 90%.

[19] To control for potential non-linearity in the relation between growth volatility and financial intermediary development, we include Private Credit in logs in the regressions.

[20] Easterly, Islam and Stiglitz (2000), for example, show that the standard deviation of growth in non-OECD countries is more than twice that in OECD countries.

[21] The correlations for the other two samples yield very similar conclusions and are available on request.

[22] The variance inflation factor for a variable X_j from a vector of regressors X is computed as $1/(1-R^2_j)$, where R^2_j is the multiple correlation coefficient from a regression of X_j on all other elements of X. A common rule of thumb is to be concerned with any value larger than 10.

[23] We also tested the sensitivity of our findings to using a fixed effects model with country and time dummies. The fixed-effects results provide stronger support for our argument, especially concerning the interaction of terms of trade volatility and intermediaries and are estimated with apparently greater precision than the results we report below. However, we believe these fixed-effects results cannot be trusted, for the reasons given by Beck and Katz (1995).

[24] This is similar to the Huber-White cluster (sandwich) error correction ($\Omega = \sum_i \left(\overline{x_i \varepsilon_j}\right)\left(\overline{\varepsilon_j x_i}\right)$), but while that method controls for differences in errors across groups, it does not allow for correlation within groups.

[25] There is a large literature showing the relationship between financial development and legal origin (La Porta et al. 1997, 1998, Beck, Demirguc-Kunt and Levine, 2003). Further, there is evidence that endowment also influences institutional development, including financial development (Easterly and Levine, 2003, Beck, Demirguc-Kunt and Levine, 2003). Finally, all these instrumental variables enter significantly in a regression of Private Credit in all samples, and explain jointly about 50% of variation.

[26] We also test for endogeneity of the stock market dummy and cannot reject exogeneity.

[27] As discussed above, finding individual insignificance and joint significance can be explained by the high multicollinearity of the individual variables.

[28] To control for the different degree with which countries are exposed to terms of trade volatility, we also ran regressions with a triple interaction of terms of trade volatility, Private Credit and trade openness, the three variables and the three bi-variate interactions. The triple interaction term did not enter significantly.

[29] We are not able to determine why our findings differ from other studies, since we use different dependent variables, a different measure of financial development and different econometric technique, each of which can explain the difference to other studies.

[30] For the effect of foreign banks on banking sector stability, see for example Peek and Rosengreen (2000) and Crystal, Dages and Goldberg (2001).

[31] See Bekaert, Harvey and Lundblad (2002) who find a dampening impact of stock market liberalization on growth volatility for the period 1980-97.

Table 1: Descriptive Statistics

Sample	Variable	Median	Mean	Standard deviation	Minimum	Maximum	countries	observations
3-period							63	169
	Sd GDP growth (x 100)	2.539	3.351	1.964	0.634	10.968		
	Real GDP per capita	3,068	8,161	9,647	135	43,886		
	Openess	50.127	60.561	46.323	9.432	364.052		
	Private credit	0.274	0.418	0.357	0.010	1.961		
	Stock market	0.000	0.492	0.504	0.000	1.000		
	Sd ToT changes	0.064	0.083	0.070	0.000	0.407		
	Sd inflation	0.036	0.093	0.217	0.006	1.619		
4-period							63	218
	Sd GDP growth (x 100)	2.519	3.244	1.972	0.507	11.573		
	Real GDP per capita	2,803	8,331	9,703	159	44,223		
	Openess	51.058	60.879	44.652	9.903	378.472		
	Private credit	0.279	0.425	0.357	0.008	2.006		
	Stock market	0.000	0.492	0.504	0.000	1.000		
	Sd ToT changes	0.055	0.081	0.071	0.000	0.472		
	Sd inflation	0.038	0.086	0.203	0.005	1.625		
6-period							63	333
	Sd GDP growth (x 100)	2.392	3.125	2.146	0.432	13.529		
	Real GDP per capita	2,802	8,201	9,640	151	44,026		
	Openess	50.807	60.751	46.711	9.129	395.609		
	Private credit	0.284	0.418	0.358	0.003	2.043		
	Stock market	0.000	0.492	0.504	0.000	1.000		
	Sd ToT changes	0.053	0.080	0.078	0.000	0.577		
	Sd inflation	0.029	0.073	0.173	0.004	1.602		

Sd GDP growth = standard deviation of annual GDP per capita growth rates
Real GDP per capita = real GDP per capita averaged over the sample period
Openess = real exports and imports as share of real GDP
Private credit = claims on nonfinancial private sector by financial institutions as share of GDP
Stock market = dummy variable that takes on value one if market capitalization as share of GDP averaged over 1975 - 97 is higher than the sample median (13.5%), zero otherwise
Sd ToT changes = standard deviation of annual terms of trade changes
Sd inflation = standard deviation of annual inflation rates

Table 2: Correlations, 1960-97, 3-period sample

Variable	Real GDP per capita	Private credit	Stock market	Openness	Sd ToT changes	Sd inflation
Correlations						
Real GDP per capita						
Private credit	0.784 ***					
Stock market	0.431 ***	0.4771 ***				
Openess	0.106	0.170 **	0.159 **			
Sd ToT changes	-0.473 ***	-0.470 ***	-0.337 ***	-0.249 ***		
Sd inflation	-0.162 **	-0.233 ***	-0.179 **	-0.151 *	0.210 ***	
Sd GDP growth	-0.417 ***	-0.395 ***	-0.268 ***	0.034	0.434 ***	0.287 ***

Sd GDP growth = standard deviation of annual GDP per capita growth rates
Real GDP per capita = real GDP per capita averaged over the sample period
Openess = real exports and imports as share of real GDP
Private credit = claims on nonfinancial private sector by financial institutions as share of GDP
Sd ToT changes = standard deviation of annual terms of trade changes
Sd inflation = standard deviation of annual inflation rates

Table 3: Terms of Trade and Inflation Volatility, Financial Intermediaries, and Growth Volatility

Dependent variable: Standard deviation of growth in real per capita GDP (x 100)

Sample	3-period	4-period	6-period	
Method 1/	OLS	OLS	OLS	AR(1)
[1] Ln(Real GDP per capita)	-0.1496	-0.1642	-0.1405	-0.0032
	(0.263)	*(0.142)*	*(0.175)*	*(0.979)*
[2] Ln(Openess)	0.6930	0.6465	0.5219	0.9369
	(0.001)	*(0.001)*	*(0.004)*	*(0.000)*
[3] Sd dToT	7.3942	10.0246	6.7336	8.3372
	(0.003)	*(0.000)*	*(0.000)*	*(0.000)*
[4] Sd Inflation	1.7157	1.8842	1.7926	1.8803
	(0.007)	*(0.007)*	*(0.008)*	*(0.009)*
[5] Ln(Private credit)	-0.4621	-0.1772	-0.3877	-0.3793
	(0.072)	*(0.434)*	*(0.057)*	*(0.119)*
[6] Intercept	2.6265	1.6661	2.8513	-0.0491
	(0.017)	*(0.114)*	*(0.002)*	*(0.949)*
LR test of homoscedasticity	425.80	1127.22	2425.12	2677.32
Chi-squared (62 df)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Exogeneity test 2/	0.65	0.11	1.16	0.50
F(1, NT-10)	*(0.421)*	*(0.738)*	*(0.283)*	*(0.481)*
Estimated serial correlation (rho)	(0.13)	(0.14)	(0.27)	
Number of countries	63	63	63	63
Number of observations	169	218	333	333

Notes

1/ P-values in parentheses

2/ Davidson-Mackinnon test

Table 4A: Terms of Trade and Inflation Volatility, Financial Intermediaries, and Growth Volatility; One Interaction

Dependent variable: Standard deviation of growth in real per capita GDP (x 100)

Sample	3-period	4-period	6-period	
Method 1/	OLS	OLS	OLS	AR(1)
[1] Ln(Real GDP per capita)	-0.1670	-0.1913	-0.1277	-0.0062
	(0.204)	*(0.082)*	*(0.217)*	*(0.960)*
[2] Ln(Openess)	0.7290	0.6792	0.5392	0.9383
	(0.001)	*(0.001)*	*(0.003)*	*(0.000)*
[3] Sd dToT	12.9930	17.6936	6.5052	9.9797
	(0.140)	*(0.000)*	*(0.207)*	*(0.057)*
[4] Sd Inflation	0.0170	-0.0701	0.8694	1.0630
	(0.987)	*(0.945)*	*(0.370)*	*(0.246)*
[5] Sd dToT * Ln(Private credit)	-2.2050	-3.0720	0.0527	-0.7072
	(0.456)	*(0.086)*	*(0.977)*	*(0.710)*
[6] Sd Inflation * Ln(Private credit)	0.8450	0.9403	0.4538	0.4118
	(0.076)	*(0.034)*	*(0.222)*	*(0.257)*
[7] Ln(Private credit)	-0.3850	-0.0435	-0.4580	-0.3865
	(0.216)	*(0.853)*	*(0.049)*	*(0.154)*
[8] Intercept	2.3910	1.3645	2.9047	-0.0047
	(0.041)	*(0.186)*	*(0.002)*	*(0.995)*
Joint significance tests (Chi-squared)				
[3] and [5] (2 df)	7.95	36.36	14.44	20.97
	(0.019)	*(0.000)*	*(0.001)*	*(0.000)*
[4] and [6] (2 df)	9.09	9.80	7.51	6.71
	(0.011)	*(0.007)*	*(0.023)*	*(0.035)*
[5], [6], and [7] (3 df)	6.74	6.06	5.62	3.60
	(0.081)	*(0.109)*	*(0.132)*	*(0.309)*
LR test of homoscedasticity	428.46	1393.62	2397.91	2570.72
Chi-squared (62 df)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Exogeneity test 2/	0.49	0.30	1.02	0.66
F(2, NT-10)	*(0.690)*	*(0.826)*	*(0.386)*	*(0.580)*
Estimated serial correlation (rho)	(0.13)	(0.13)	(0.27)	
Number of countries	63	63	63	63
Number of observations	169	218	333	333

Notes

1/ P-values in parentheses

2/ Davidson-Mackinnon test

Table 4B: Partial Derivatives: Marginal Impact of Terms of Trade and Inflation Volatility and Financial Intermediaries on Growth Volatility (from Table 4A)

Sample	3-period	4-period	6-period	
Method 1/	OLS	OLS	OLS	AR(1)
Impact of terms of trade volatility on growth volatility				
25th %ile financial development	6.66	8.88	6.65	8.00
	(0.007)	*(0.000)*	*(0.000)*	*(0.000)*
50th %ile financial development	5.70	7.47	6.68	7.61
	(0.042)	*(0.002)*	*(0.002)*	*(0.001)*
75th %ile financial development	4.11	5.20	6.72	7.09
	(0.333)	*(0.132)*	*(0.034)*	*(0.034)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.456)*	*(0.086)*	*(0.977)*	*(0.710)*
Impact of inflation volatility on growth volatility				
25th %ile financial development	2.45	2.63	2.14	2.22
	(0.003)	*(0.002)*	*(0.006)*	*(0.010)*
50th %ile financial development	2.81	3.06	2.39	2.44
	(0.003)	*(0.002)*	*(0.008)*	*(0.013)*
75th %ile financial development	3.42	3.75	2.73	2.75
	(0.006)	*(0.002)*	*(0.012)*	*(0.020)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.076)*	*(0.034)*	*(0.222)*	*(0.257)*

Notes

1/ P-values in parentheses

Table 5A: Terms of Trade and Inflation Volatility, Financial Intermediaries, and Growth Volatility; Two Interactions

Dependent variable: Standard deviation of growth in real per capita GDP (x 100)

Sample	3-period	4-period	6-period	
Method 1/	OLS	OLS	OLS	AR(1)
[1] Ln(Real GDP per capita)	-0.1852	-0.2098	-0.1424	-0.0134
	(0.153)	*(0.058)*	*(0.168)*	*(0.913)*
[2] Ln(Openess)	0.7503	0.6930	0.5475	0.9306
	(0.001)	*(0.001)*	*(0.003)*	*(0.000)*
[3] Sd dToT	15.3045	18.9817	7.3370	10.2524
	(0.095)	*(0.000)*	*(0.171)*	*(0.062)*
[4] Sd Inflation	-0.2516	-0.2862	0.7209	1.0035
	(0.816)	*(0.788)*	*(0.476)*	*(0.290)*
[5] Sd dToT * Ln(Private credit)	-3.3889	-3.8591	-0.4944	-0.8976
	(0.295)	*(0.060)*	*(0.808)*	*(0.674)*
[6] Sd dToT * Ln(Private credit) * Stock Market	1.5317	1.0148	0.7884	0.2548
	(0.212)	*(0.339)*	*(0.416)*	*(0.813)*
[7] Sd Inflation * Ln(Private credit)	0.9965	1.0594	0.5297	0.4264
	(0.063)	*(0.033)*	*(0.209)*	*(0.290)*
[8] Sd Inflation * Ln(Private credit) * Stock Market	-0.2505	-0.2129	-0.0418	0.0780
	(0.708)	*(0.773)*	*(0.953)*	*(0.923)*
[9] Ln(Private credit)	-0.3853	-0.0439	-0.4612	-0.3893
	(0.211)	*(0.852)*	*(0.047)*	*(0.150)*
[11] Intercept	2.4005	1.4474	2.9817	0.067
	(0.036)	*(0.156)*	*(0.001)*	*(0.931)*
Joint significance tests (Chi-squared)				
[3], [5], and [6] (3 df)	9.80	38.46	15.40	20.90
	(0.020)	*(0.000)*	*(0.002)*	*(0.000)*
[4], [7], and [8] (3 df)	9.23	9.94	7.61	6.73
	(0.026)	*(0.019)*	*(0.055)*	*(0.081)*
[5], [6], [7], [8], and [9] (5 df)	7.62	6.49	6.10	3.72
	(0.178)	*(0.261)*	*(0.296)*	*(0.591)*
LR test of homoscedasticity	515.19	1166.69	2346.30	2585.61
Chi-squared (62 df)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Exogeneity test 2/	0.79	0.33	0.90	1.30
F(3, NT-11)	*(0.562)*	*(0.892)*	*(0.482)*	*(0.264)*
Estimated serial correlation (rho)	(0.15)	(0.12)	(0.26)	
Number of countries	63	63	63	63
Number of observations	169	218	333	333

Notes

1/ P-values in parentheses

2/ Davidson-Mackinnon test

Table 5B: Partial Derivatives: Marginal Impact of Terms of Trade and Inflation Volatility and Financial Intermediaries on Growth Volatility (from Table 5A)

Sample	3-period	4-period	6-period	
Method 1/	OLS	OLS	OLS	AR(1)
Impact of terms of trade volatility on growth volatility,countries with less developed stock markets				
25th %ile financial development	5.57	7.91	5.95	7.74
	(0.031)	*(0.000)*	*(0.003)*	*(0.000)*
50th %ile financial development	4.10	6.14	5.68	7.25
	(0.197)	*(0.031)*	*(0.028)*	*(0.010)*
75th %ile financial development	1.65	3.29	5.31	6.58
	(0.738)	*(0.426)*	*(0.161)*	*(0.109)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.296)*	*(0.060)*	*(0.808)*	*(0.674)*
Impact of terms of inflation volatility on growth volatility, countries with less developed stock markets				
25th %ile financial development	2.61	2.75	2.20	2.20
	(0.005)	*(0.003)*	*(0.011)*	*(0.018)*
50th %ile financial development	3.04	3.24	2.49	2.43
	(0.006)	*(0.003)*	*(0.013)*	*(0.023)*
75th %ile financial development	3.76	4.02	2.89	2.75
	(0.009)	*(0.004)*	*(0.021)*	*(0.035)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.063)*	*(0.033)*	*(0.209)*	*(0.290)*
Impact of terms of trade volatility on growth volatility, countries with developed stock markets				
25th %ile financial development	9.34	9.67	8.30	8.15
	(0.010)	*(0.002)*	*(0.003)*	*(0.005)*
50th %ile financial development	8.09	7.88	8.47	7.77
	(0.071)	*(0.034)*	*(0.011)*	*(0.030)*
75th %ile financial development	7.14	6.50	8.62	7.44
	(0.194)	*(0.137)*	*(0.032)*	*(0.083)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.520)*	*(0.103)*	*(0.871)*	*(0.734)*
Impact of inflation volatility on growth volatility, countries with developed stock markets				
25th %ile financial development	2.14	2.48	2.32	2.66
	(0.241)	*(0.253)*	*(0.274)*	*(0.278)*
50th %ile financial development	2.65	3.02	2.61	2.96
	(0.229)	*(0.240)*	*(0.293)*	*(0.303)*
75th %ile financial development	3.03	3.43	2.85	3.21
	(0.224)	*(0.235)*	*(0.307)*	*(0.321)*
Test of equality of impacts at 25th and 75th percentiles (p-value)	*(0.235)*	*(0.225)*	*(0.467)*	*(0.508)*

Notes

1/ P-values in parentheses

Appendix Table 1: Countries Included in Sample

High income (24)[1]

Australia, Austria, Belgium, Canada, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Iceland, Israel, Italy, Japan, Korea, Netherlands, Norway, New Zealand, Portugal, Singapore, Sweden, Switzerland, United States

Upper-middle income (8)

Argentina, Brazil, Chile, Mexico, Mauritius, Malaysia, South Africa, Uruguay

Lower-middle income (18)

Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, Fiji, Jordan, Sri Lanka, Morocco, Panama, Peru, Philippines, Papua New Guinea, Paraguay, Swaziland, Syria, Thailand, St. Vincent

Low income (13)

Burundi, Bangladesh, Cameroon, Ghana, Haiti, India, Kenya, Lesotho, Nepal, Pakistan, Sierra Leone, Congo (Zaire), Zimbabwe

[1] Income groups according to the *World Development Indicators* database.

Appendix Table 2: Definitions and Sources of Data

Variable	Definition	Source
Sd GDP growth	Within-period standard deviation of annual change in ln(Real GDP per capita)	World Bank, World Development Indicators database (WDI)
Real GDP per capita	1995 dollars	WDI
Openess	Sum of real exports and imports as share of real GDP	WDI
Private credit	Claims on the private sector by financial intermediaries as share of GDP	Beck, Demirguc-Kunt and Levine (2000)
Stock market	Dummy variable that takes value one if market capitalization as share of GDP, averaged over 1975-97, is larger than the sample median (13.5%)	Beck, Demirguc-Kunt and Levine (2000)
Sd ToT changes	Within-period standard deviation of the annual change in the ratio of import and export price indices	WDI
Sd inflation	Within-period standard deviation of the December-to-December change in the consumer price index	WDI
Legal origin	Dummies indicating source of legal tradition (British, French, German, Scandinavian, Socialist)	La Porta, Lopez-de-Silanes, Shleifer and Vishny (1999)
Commodity exporter	Dummy indicating primary exports comprise more than half of total exports	WDI
Urban	Urban share of population	WDI